

# Where the Surber Stops: Groundwater Communities Below the Stream Bed

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Surface Water Quality Monitoring Workshop,  
November 3, 2016

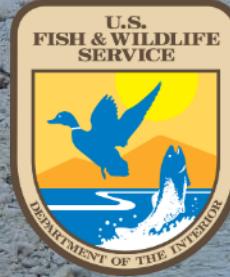
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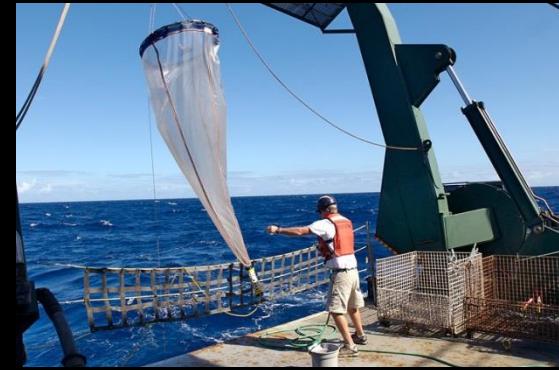
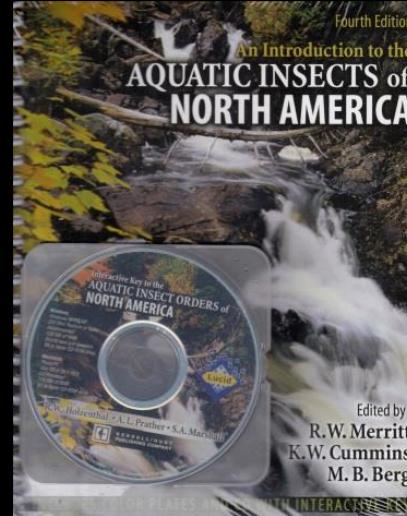
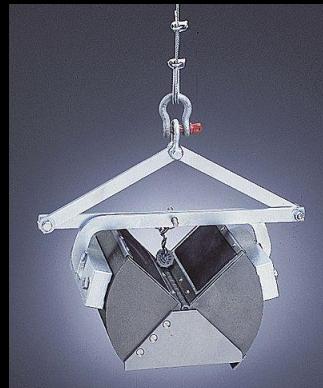
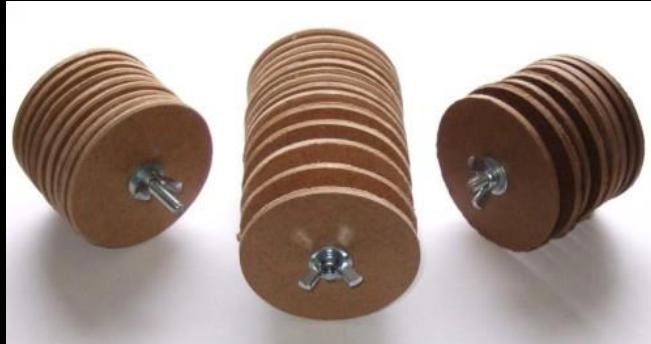


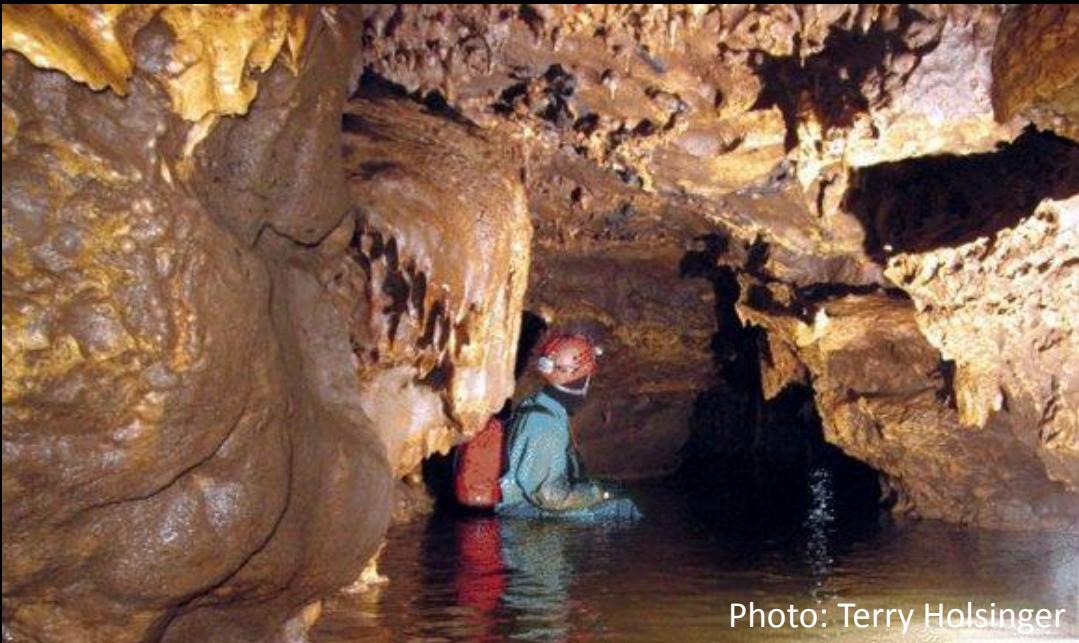
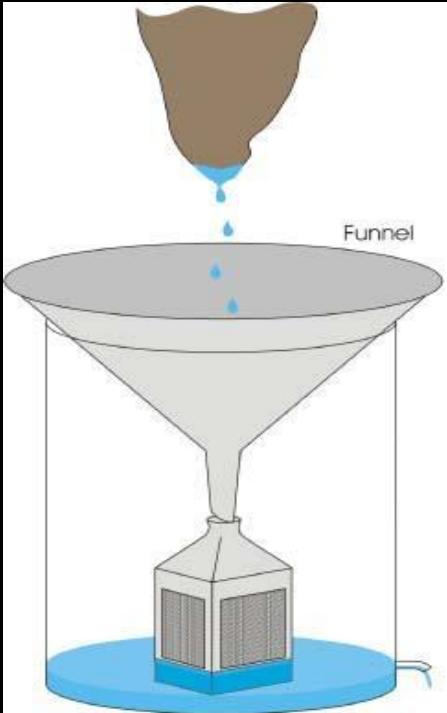
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# Aquatic Biology is Shallow

- Biomonitoring efforts
  - Biodiversity patterns
- Surface vs. groundwater regulation

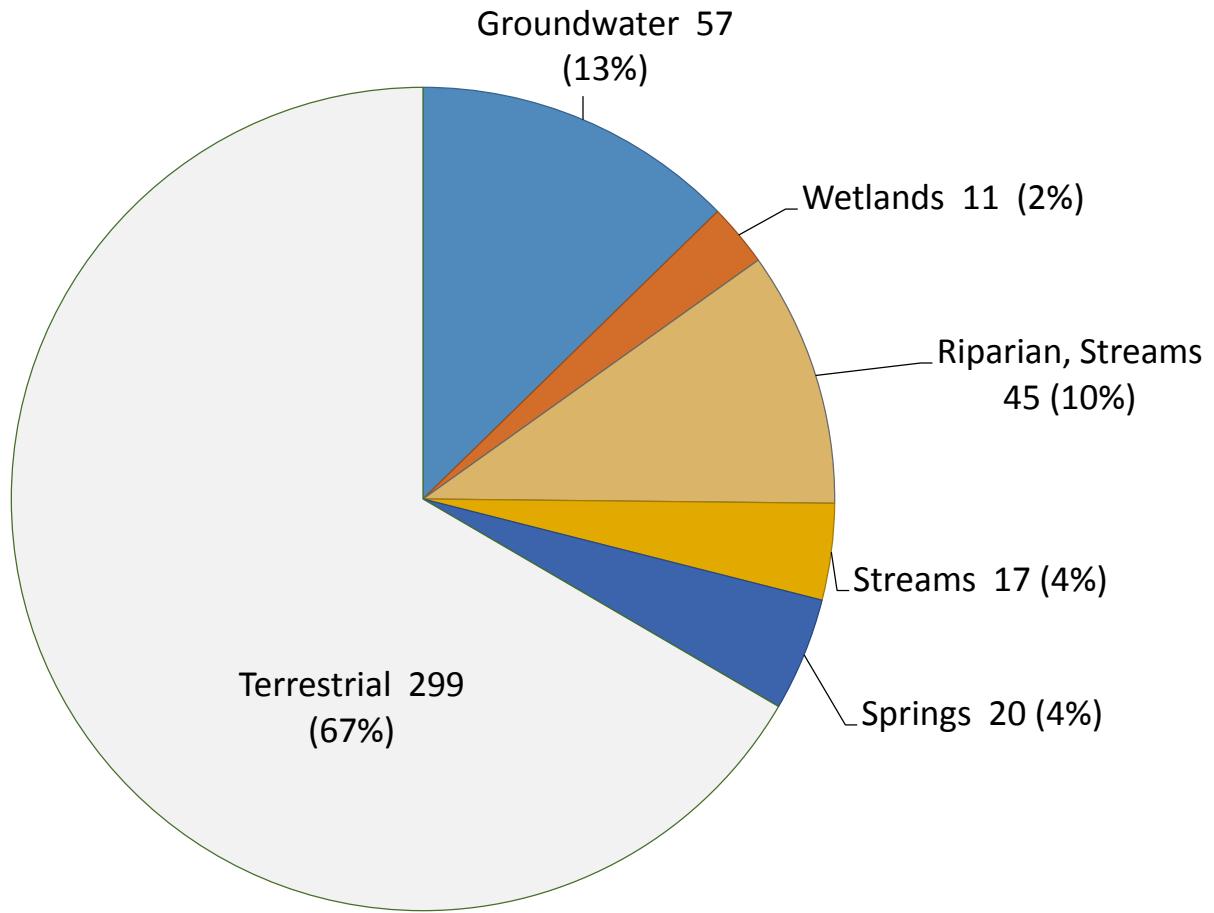




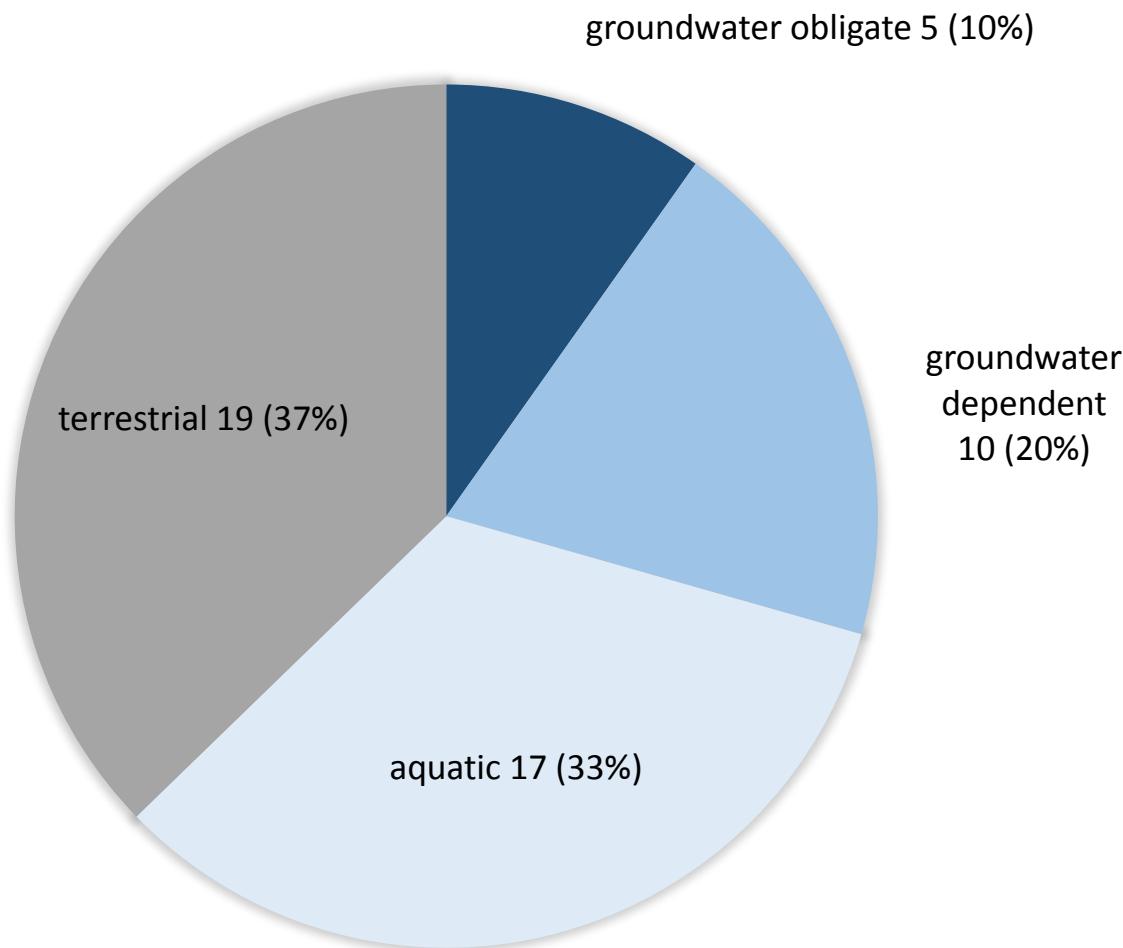
Culver, D. C. & T. Pipan. 2011. Ecohydrology 4: 721-730.

# Biodiversity and rarity

- 150 of 449  
‘Species of Greatest Conservation Need’



# Why care about groundwater taxa?



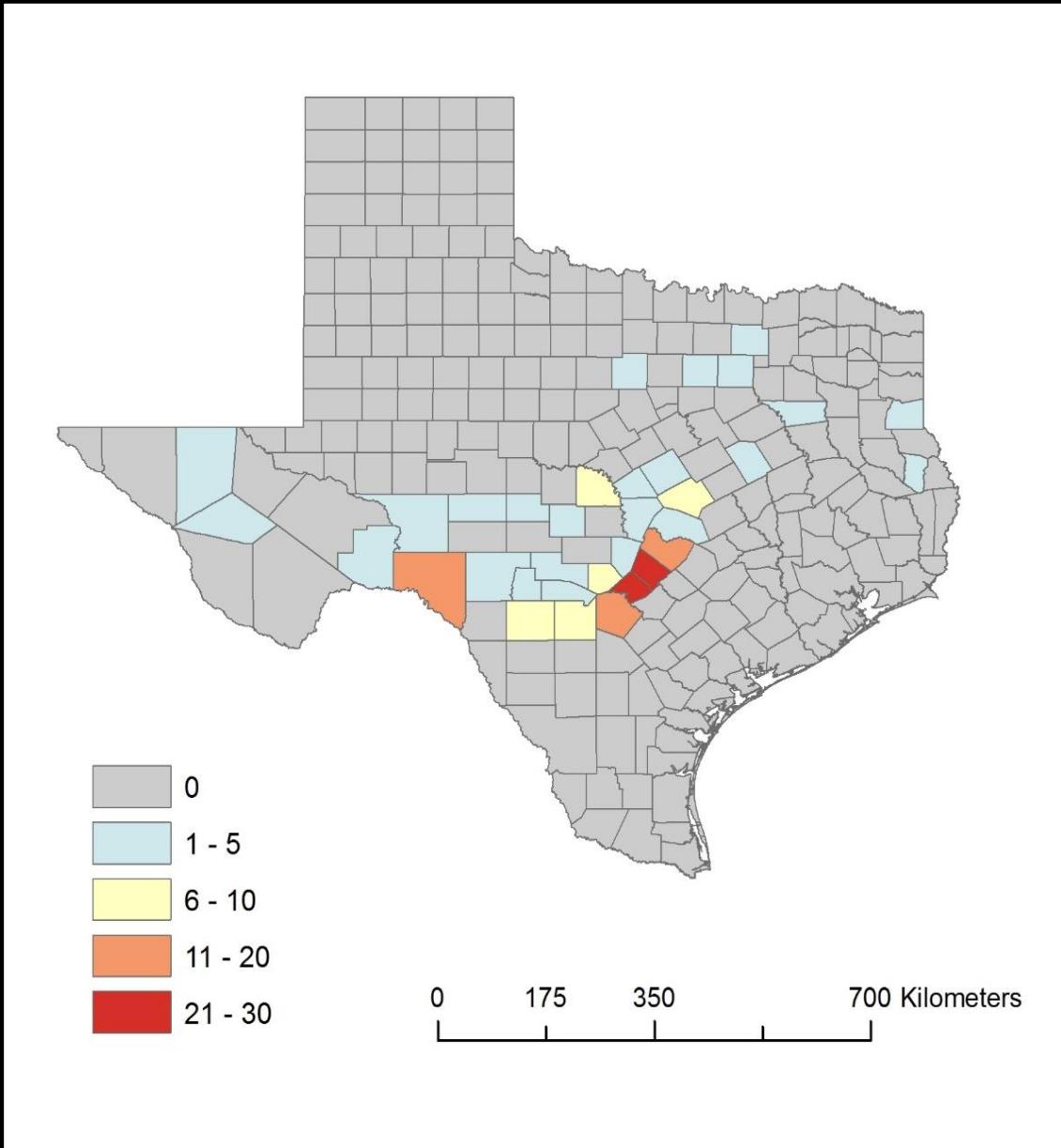
# Texas groundwater fauna

- 64 invertebrate species
  - (91% state endemics)
  - Diverse origins



Photo: J. Krejca, Zara Environmental LLC

# Species richness by county



# Conservation Status Ranks

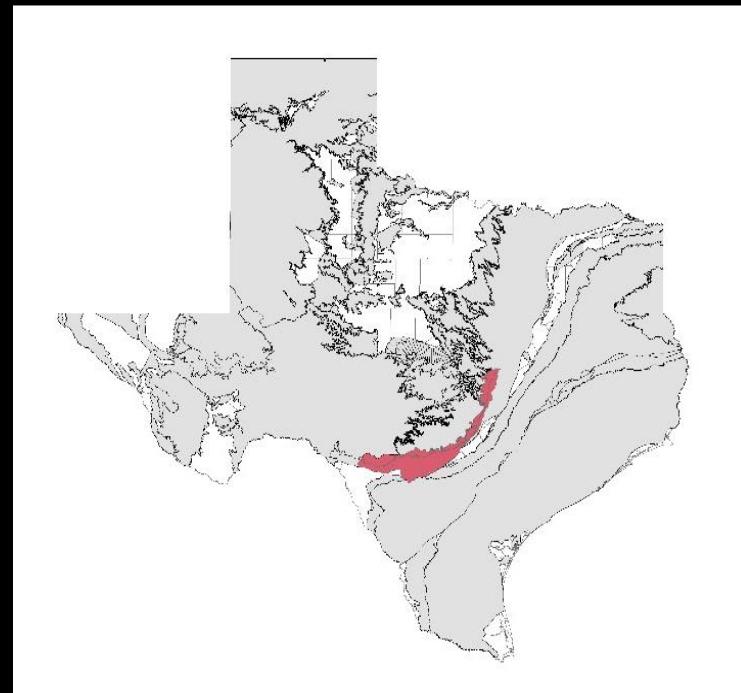
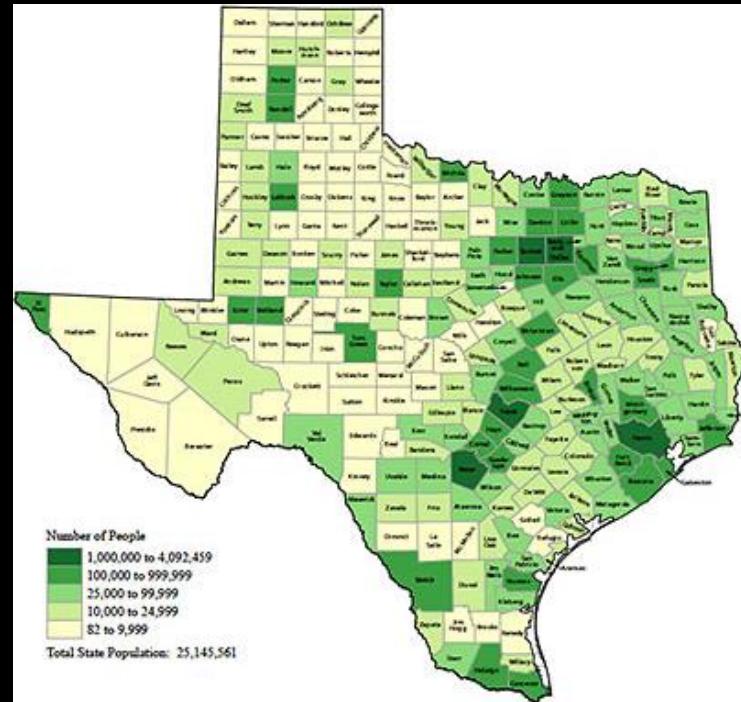
## NatureServe Methodology

Factor Category	Weight	Factor	Factor Weight
Rarity	0.7	Range Extent	1
		Area of Occupancy	2
		Population Size	2
		Number of Occurrences	1
		Number of Secure Occurrences	2
Threats	0.3	Threat Impact	1

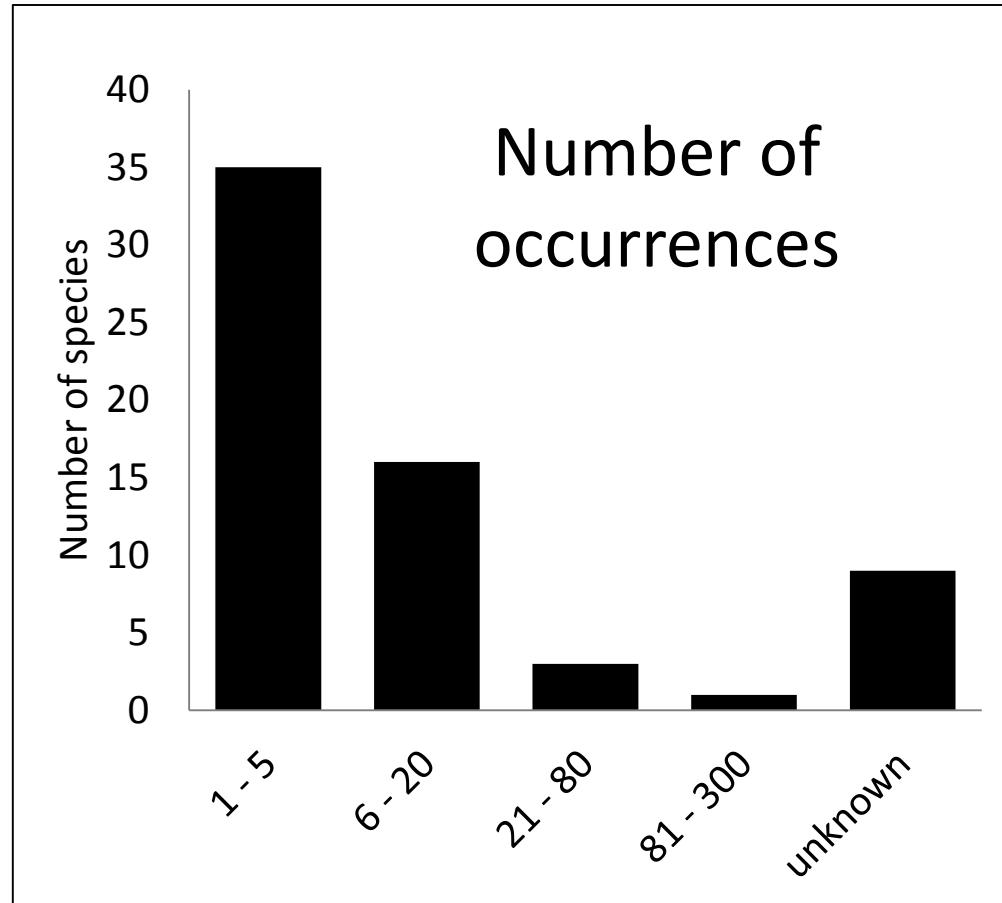
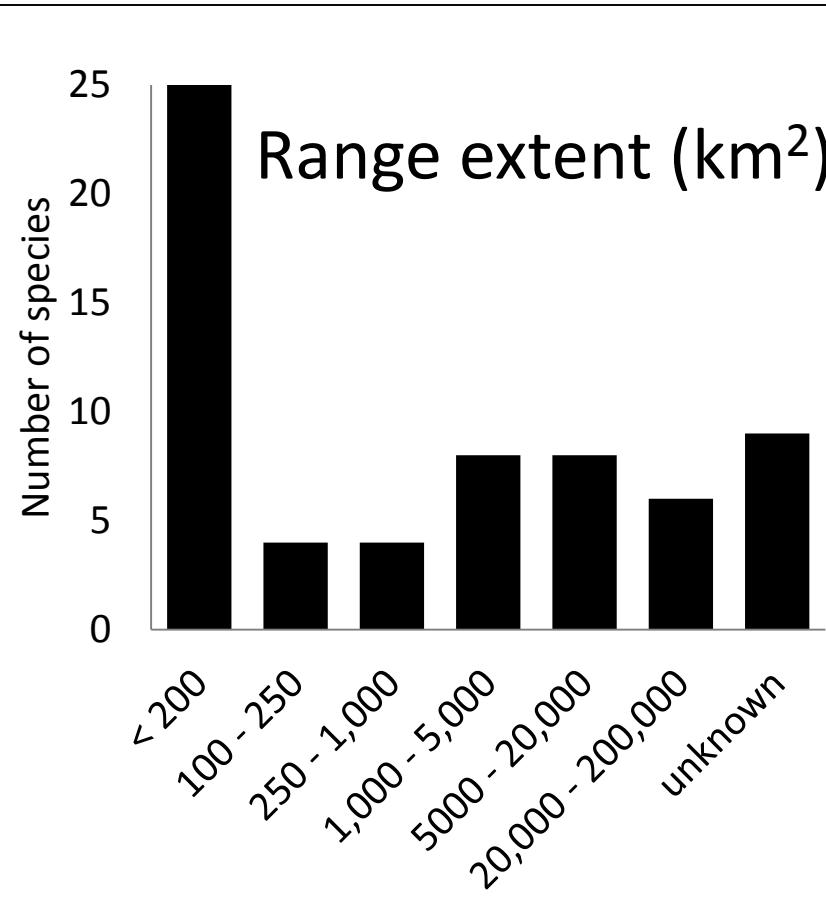
Value Range for Calculated Score	Calculated Status Rank	Status Description
score ≤1.5	S1	Critically imperiled
1.5 < score ≤2.5	S2	Imperiled
2.5 < score ≤3.5	S3	Vulnerable
3.5 < score ≤4.5	S4	Apparently secure
score >4.5	S5	Secure

“Whiskey is  
for drinking...”

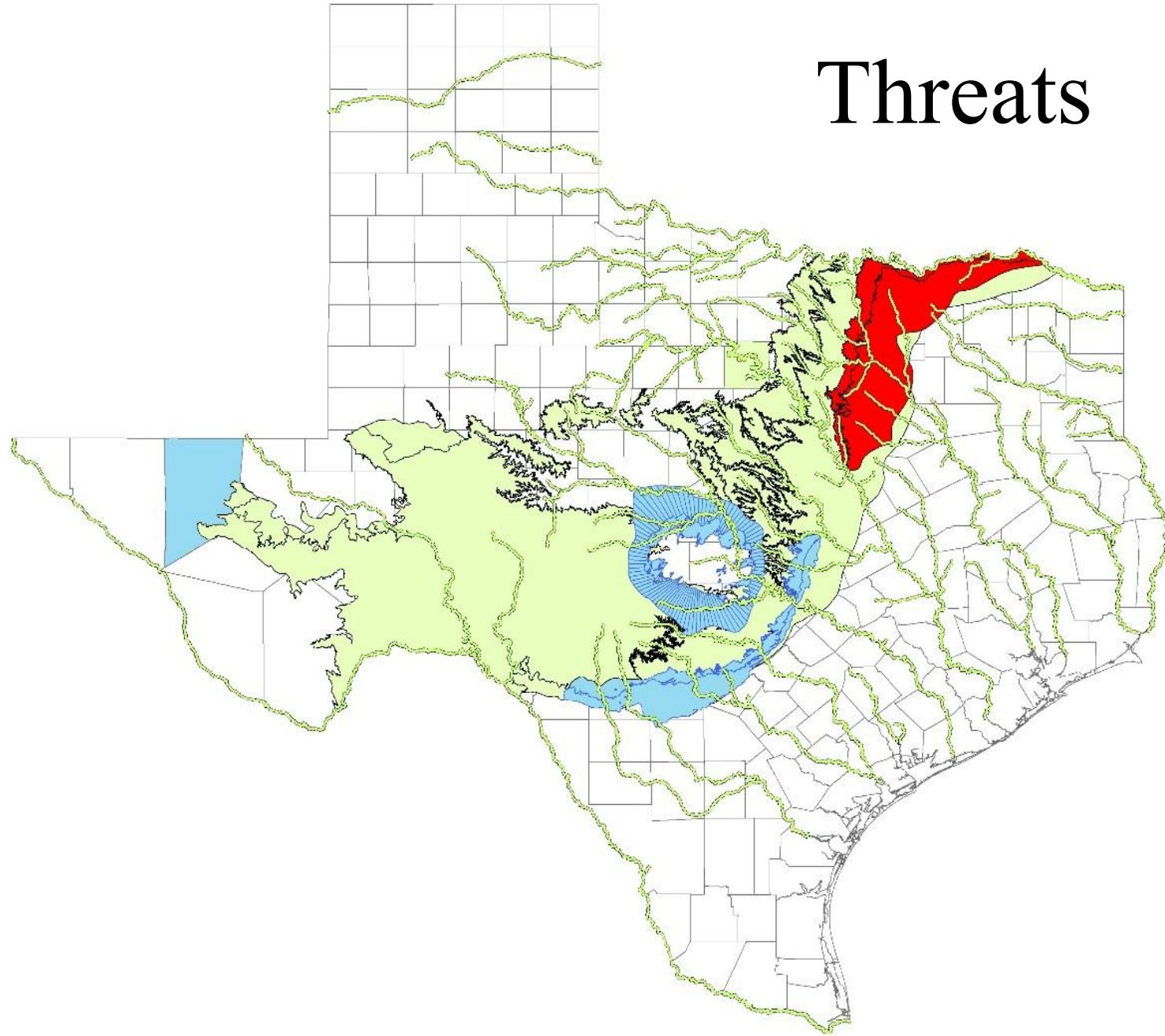
- Threats
    - Water extraction
    - Domestic & urban effluents
    - Oil & gas
    - Farming & ranching
    - Agricultural effluents



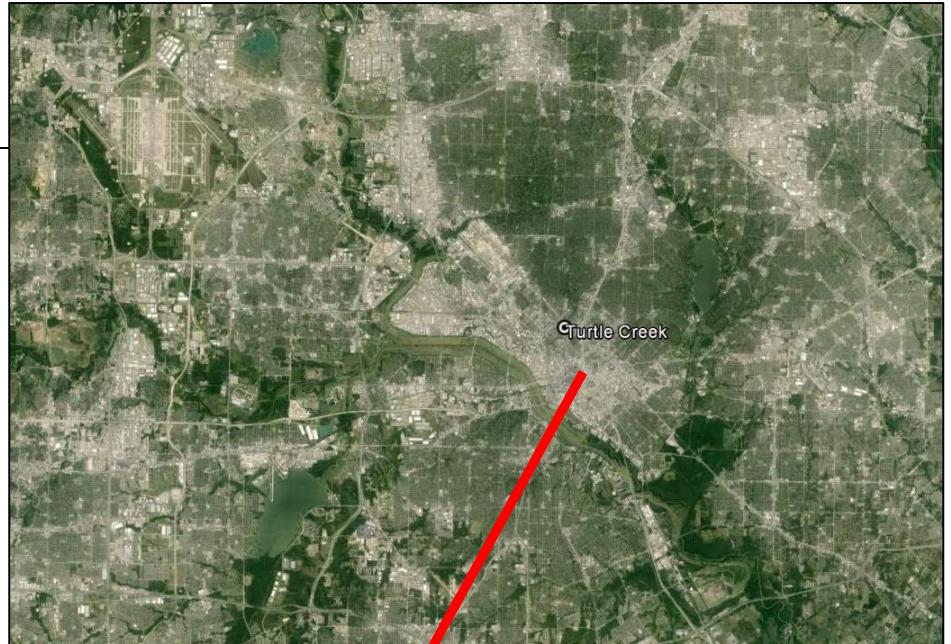
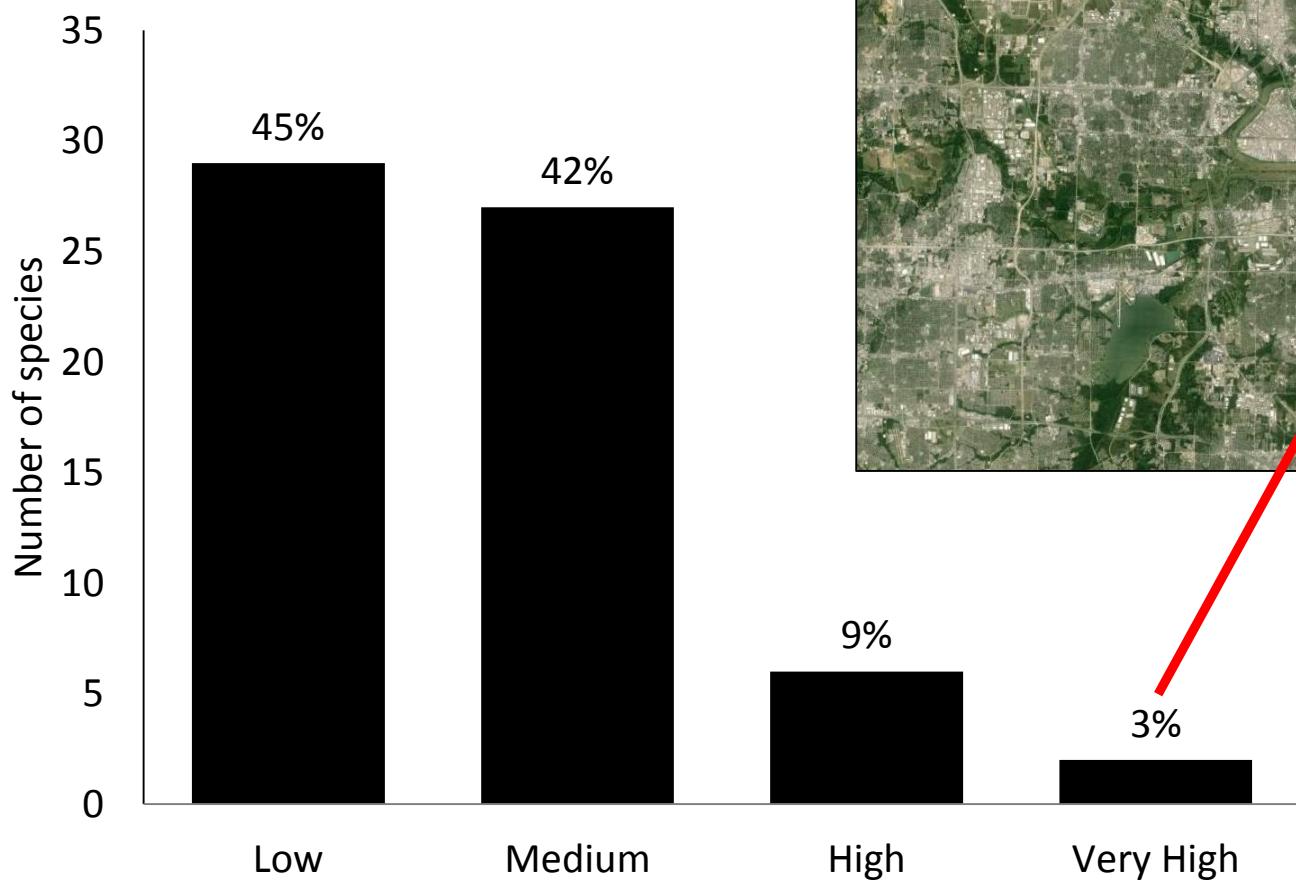
# Rarity



# Threats



# Threats



# Results

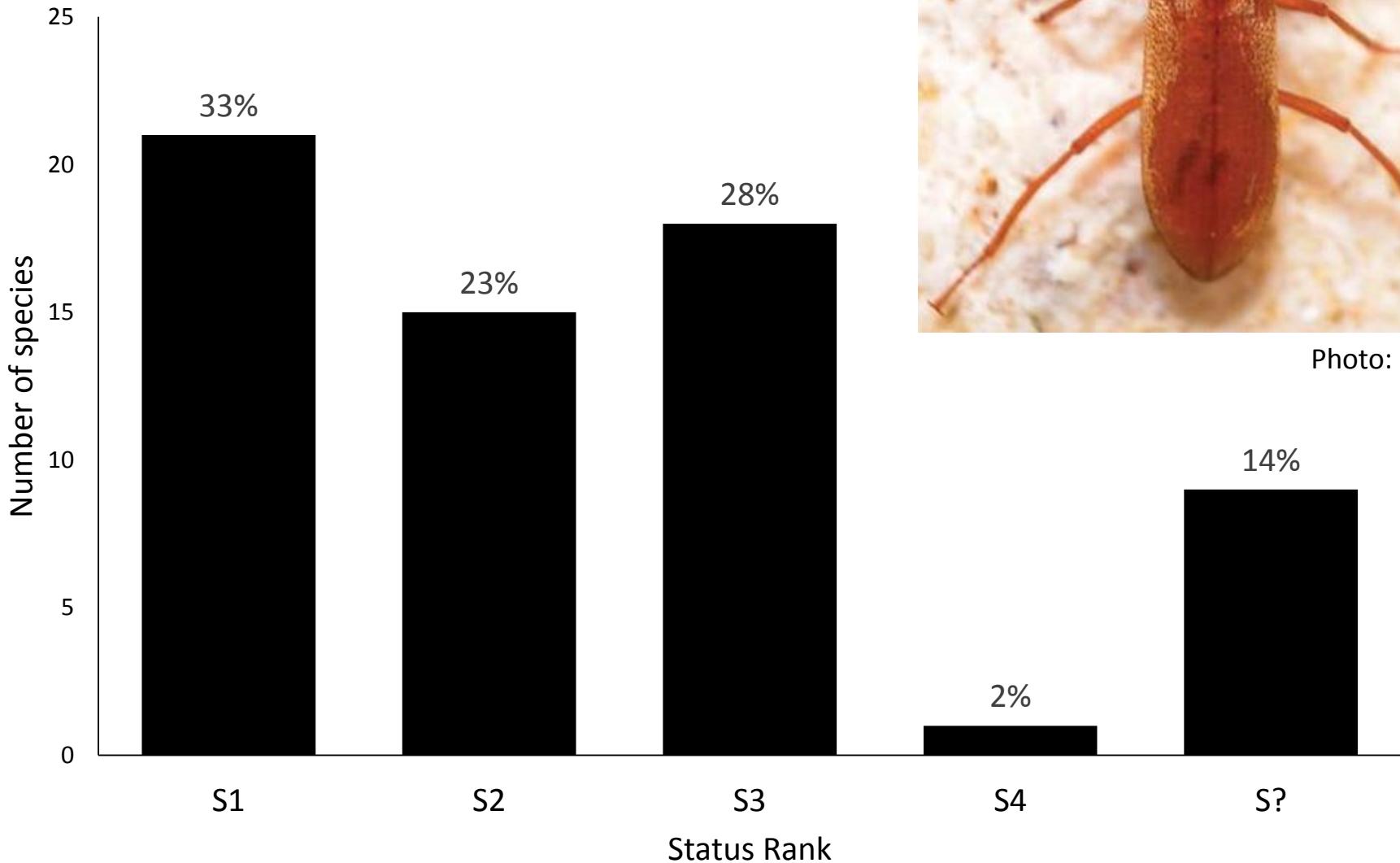


Photo: USFWS

# Beetles & Snails

Ponder & Colgan (2002)



- 12 spp.
- 9 S1 – S2



- 8 spp.
- All S1

# Looking deeper

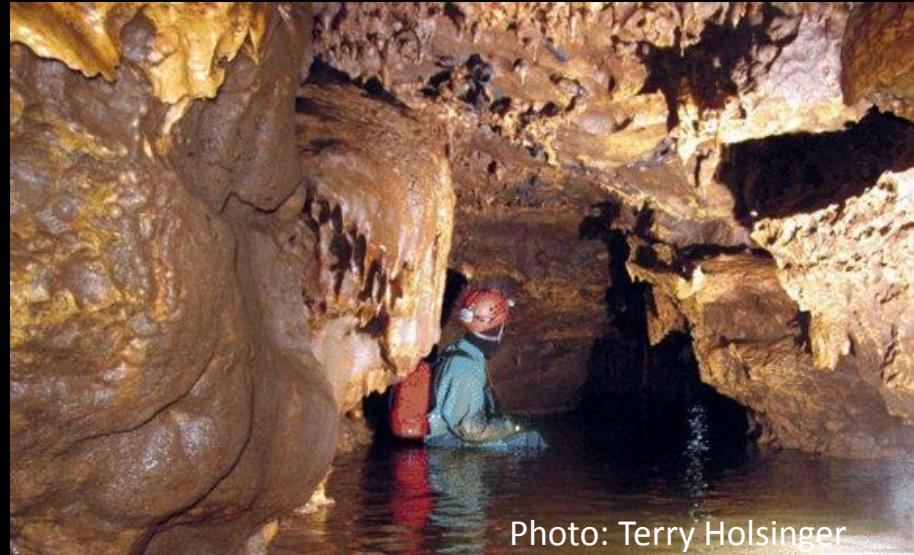
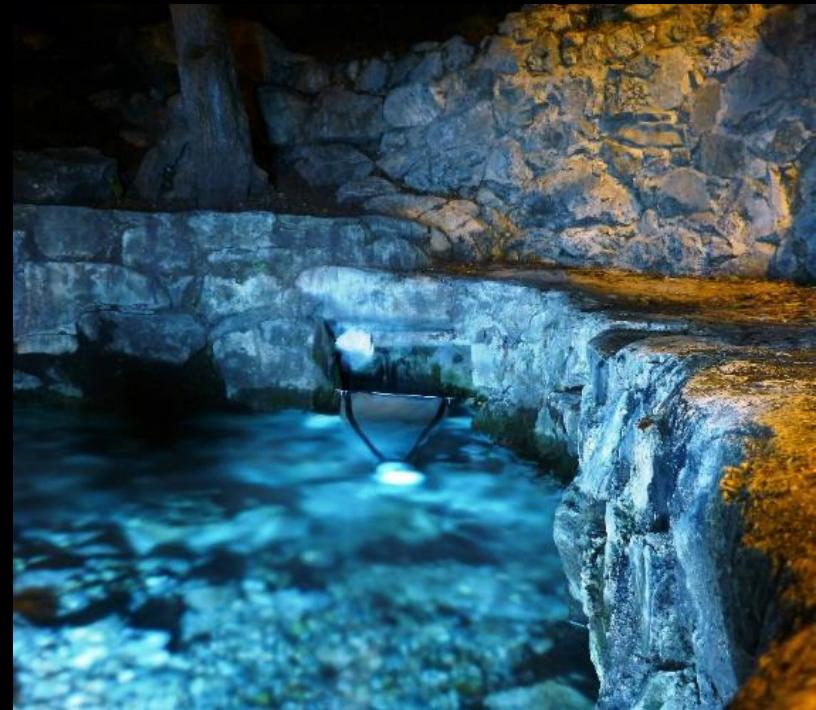
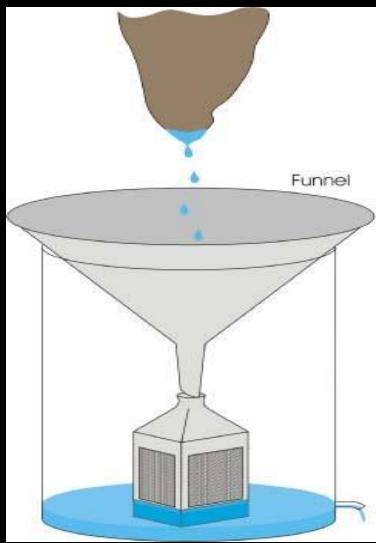
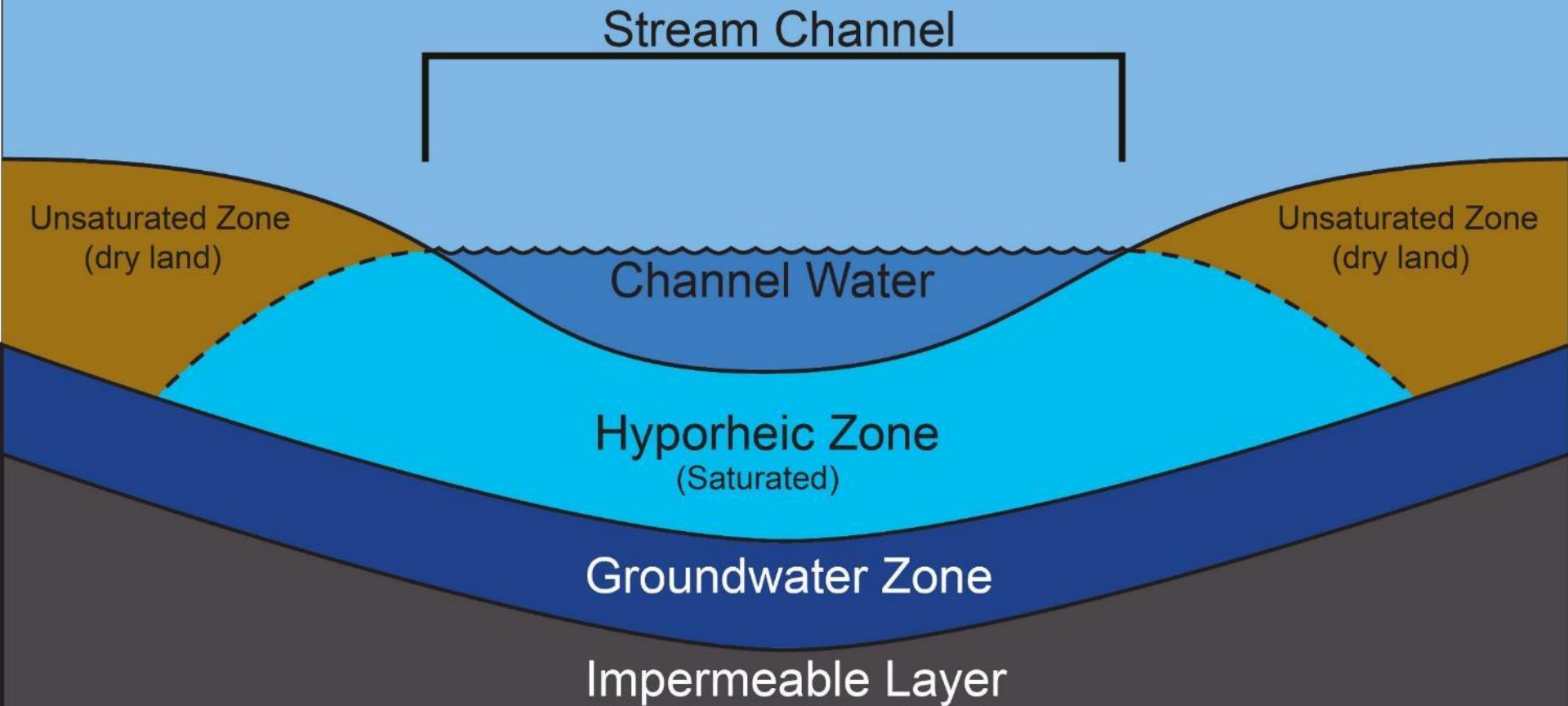


Photo: Terry Holsinger

# Looking deeper (but not too deep)

Diagram of the Hyporheic Zone



# Why is it important?

- Primary habitat
- Dispersal corridor
- Accessible & extensive



# Hyporheic inventories in U.S.A.

Boulton, A. J., H. M. Valett, S. G. Fisher. 1992. Spatial distribution and taxonomic composition of the hyorheos of several Sonoran Desert streams. " Archiv fur Hydrobiologie 125:37-61.

Pennak, R., and J. V. Ward. "Interstitial fauna communities of the hyporheic and adjacent groundwater biotopes of a Colorado mountain stream." Archiv für Hydrobiologie. Supplementband. Monographische Beiträge 74.3 (1986): 356-396.

Griffith, M. B., and S. A. Perry. "The distribution of macroinvertebrates in the hyporheic zone of two small Appalachian headwater streams." Archiv für Hydrobiologie 126.3 (1993): 373-384.

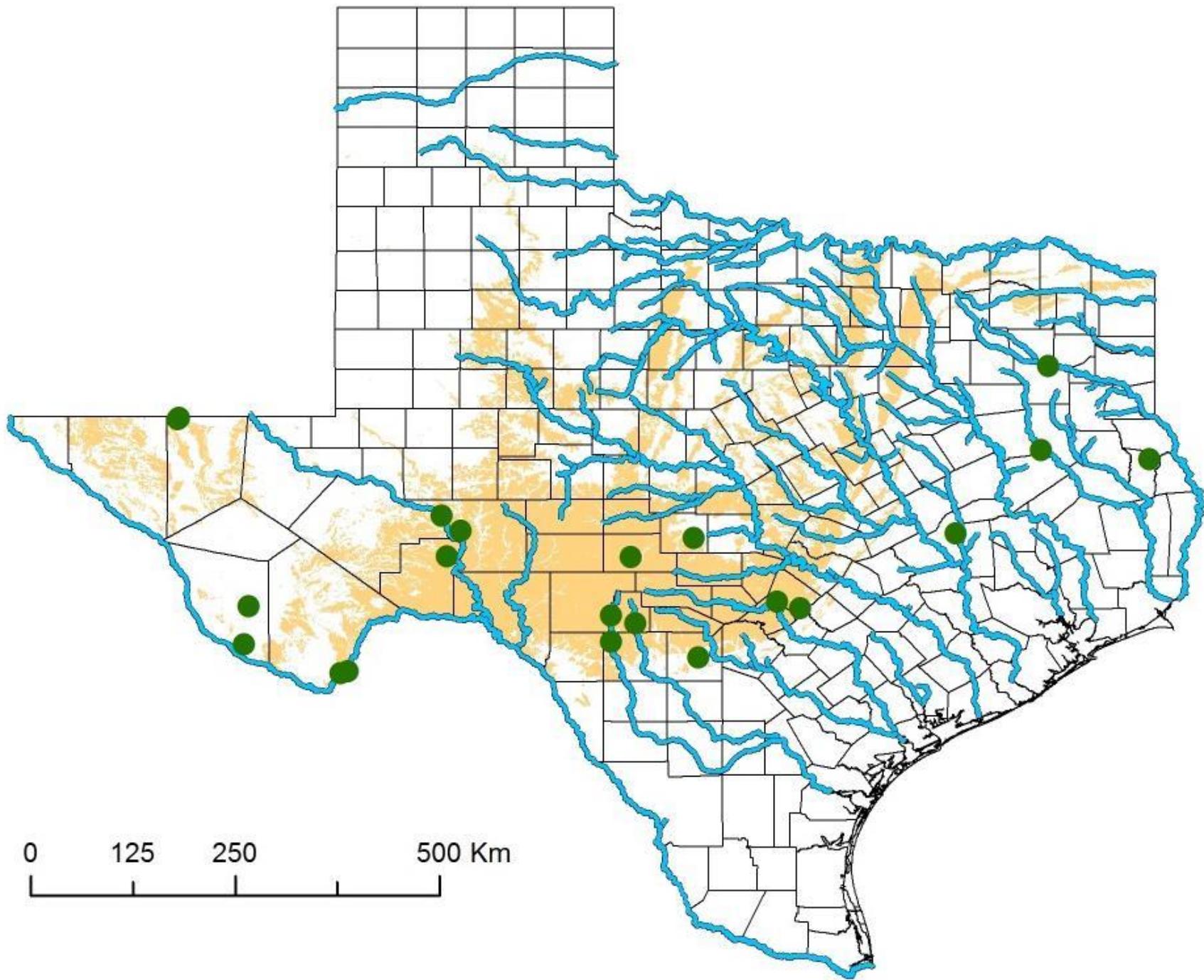
McElravy, E. P, and V.H. Resh. 1991. "Distribution and seasonal occurrence of the hyporheic fauna in a northern California stream. Hydrobiologia 220: 233-246.

Stanford, J. A., and A. R. Gaufin. 1974. Hyporheic communities of two Montana rivers. Science 185: 700-702.

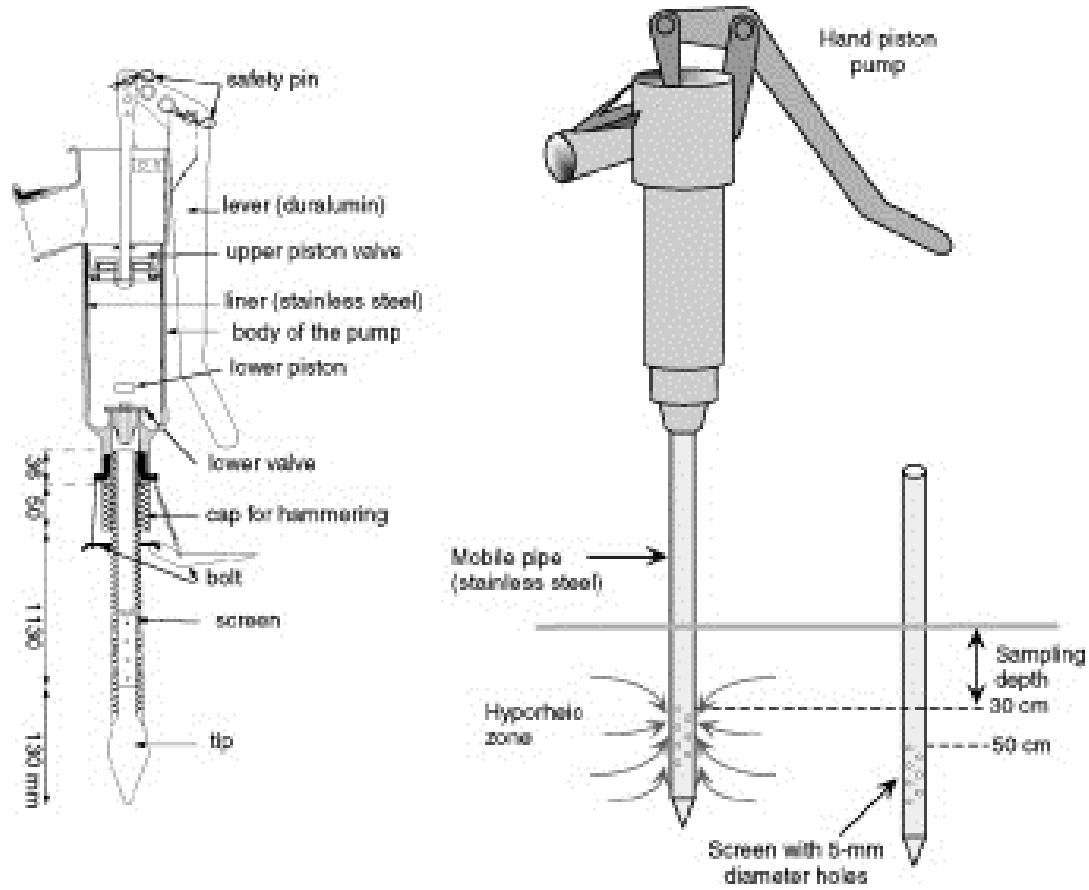
Richards, C., and K. L. Bacon. 1994. Influence of fine sediment on macroinvertebrate colonization of surface and hyporheic stream substrates. Great Basin Naturalist 54: 106-113.

Ward, J. V., and N. J. Voelz. 1994. Groundwater fauna of the South Platte River system, Colorado. In Gibert, Danielopol and Stanford (eds). 1994. Groundwater Ecology. San Diego.

Strayer, D. L., S. M. May, P. Nielsen, W. Wollheim, and S. Hausam. 1995. An endemic groundwater fauna in unglaciated eastern North America. Canadian Journal of Zoology 73: 502-508.



# Looking deeper (but not too deep)



Culver, D. C. & T. Pipan. 2011. Ecohydrology 4: 721-730.

# Methods

- 22 sites
- 3 replicates \* 2 visits
- 9L H<sub>2</sub>O filtered at 200 µm  
in 95% ETOH
- Physicochemistry, ions, δD  
+ δ<sup>18</sup>O isotopes
- Samples sorted at 10X  
mag.



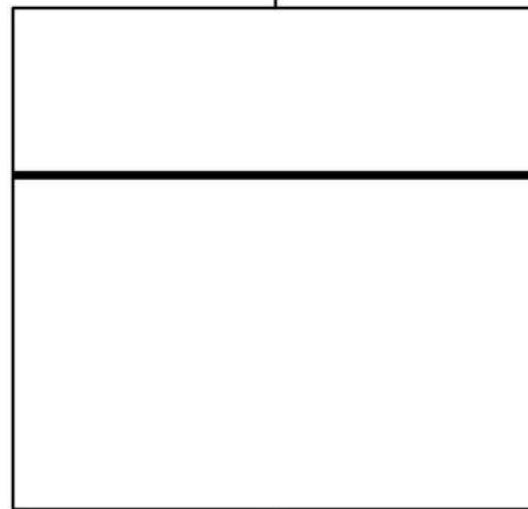
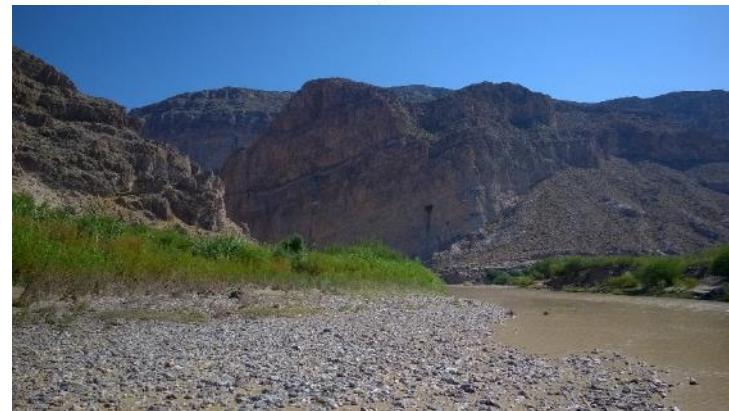
Species Richness

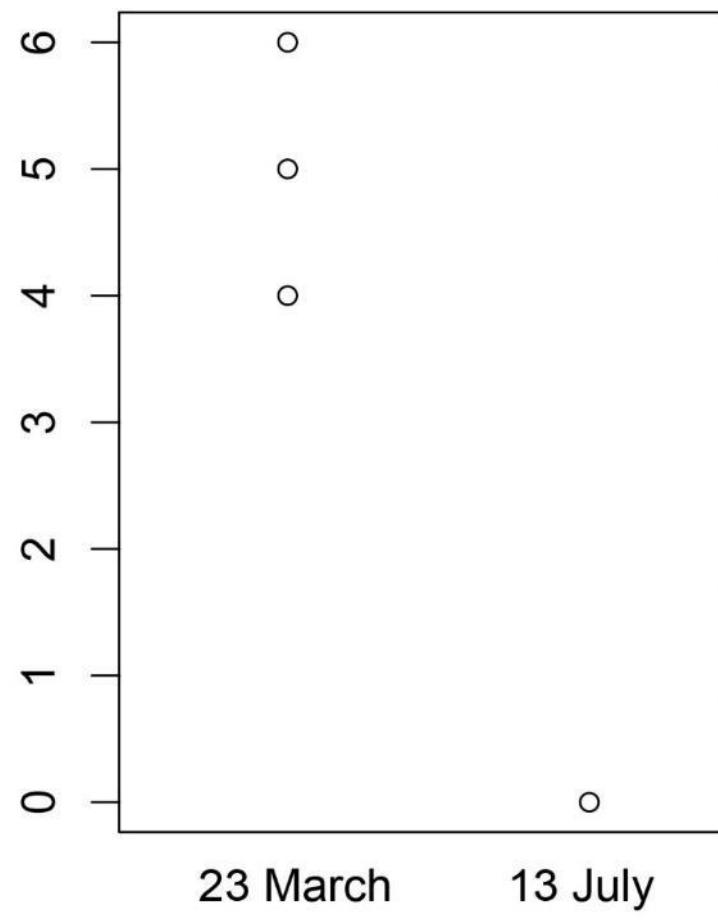
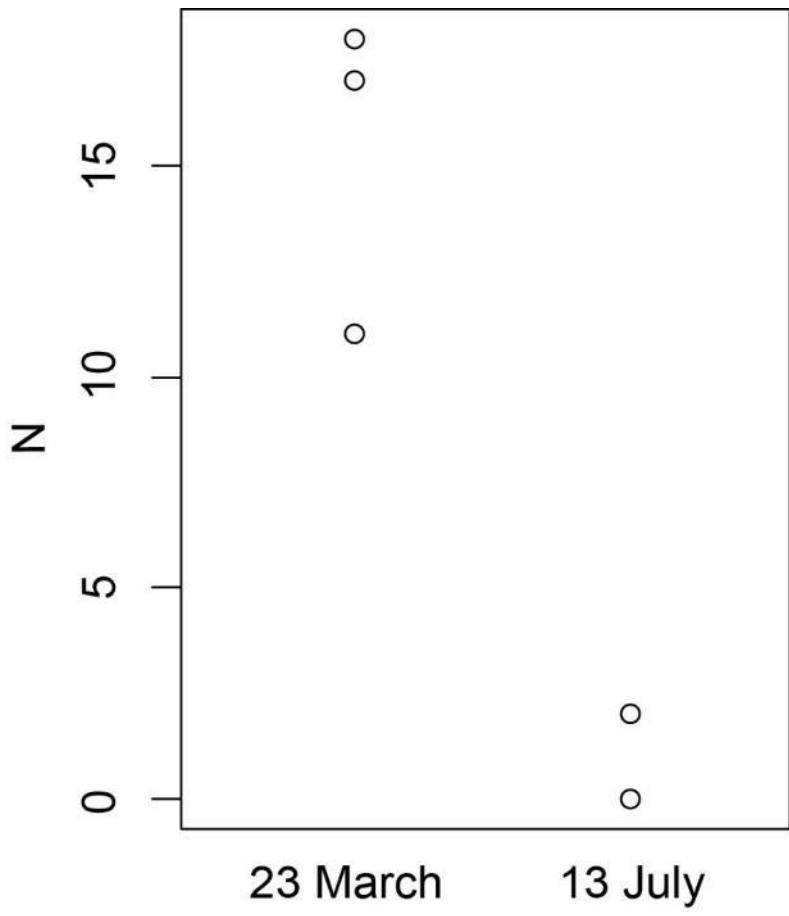
6  
5  
4  
3  
2  
1  
0



Non Karst

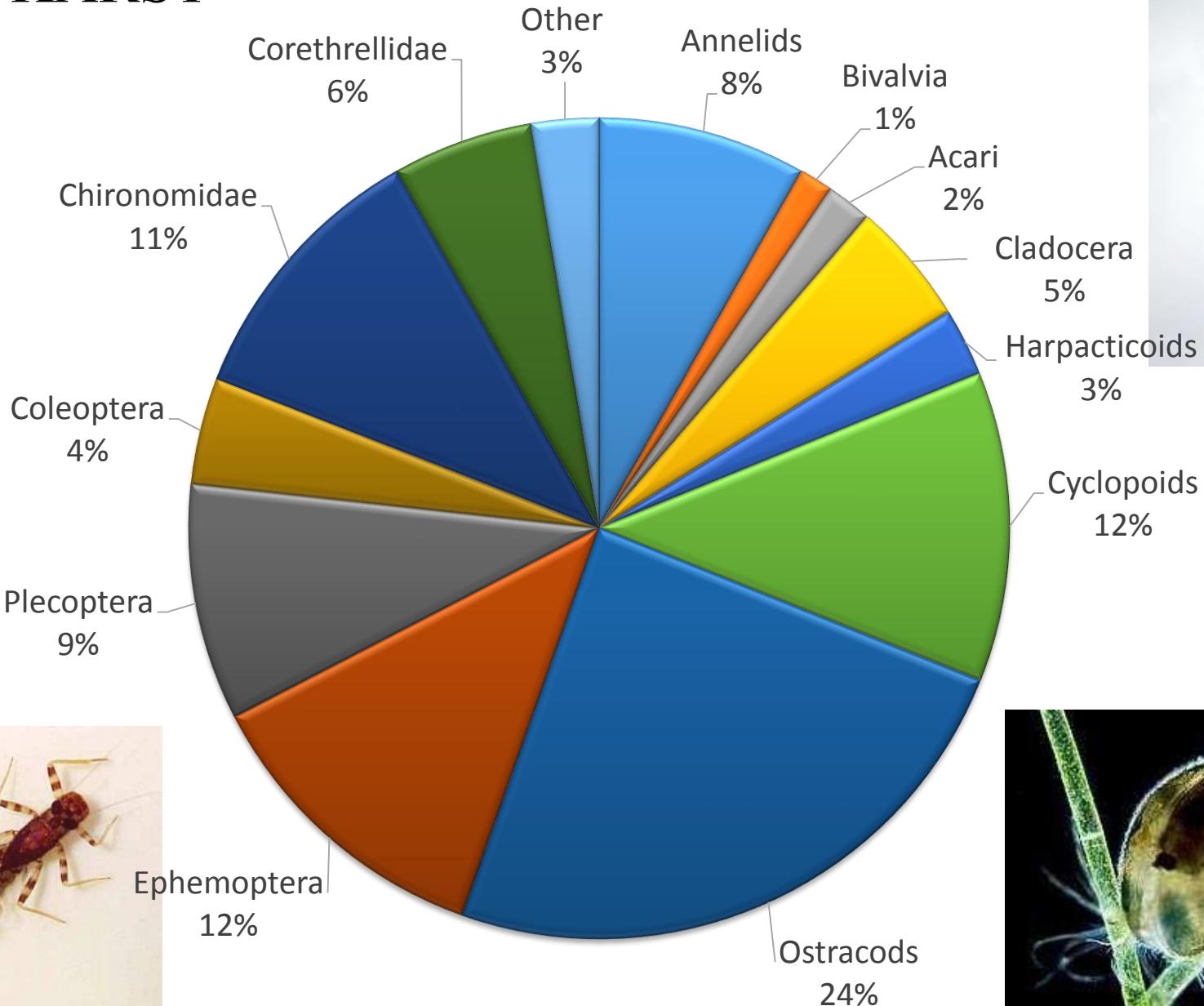
Karst





- RDA & permutation test ( $F = 0.49 (1,12)$ ,  $p = 0.78$ )

# NON KARST



# KARST

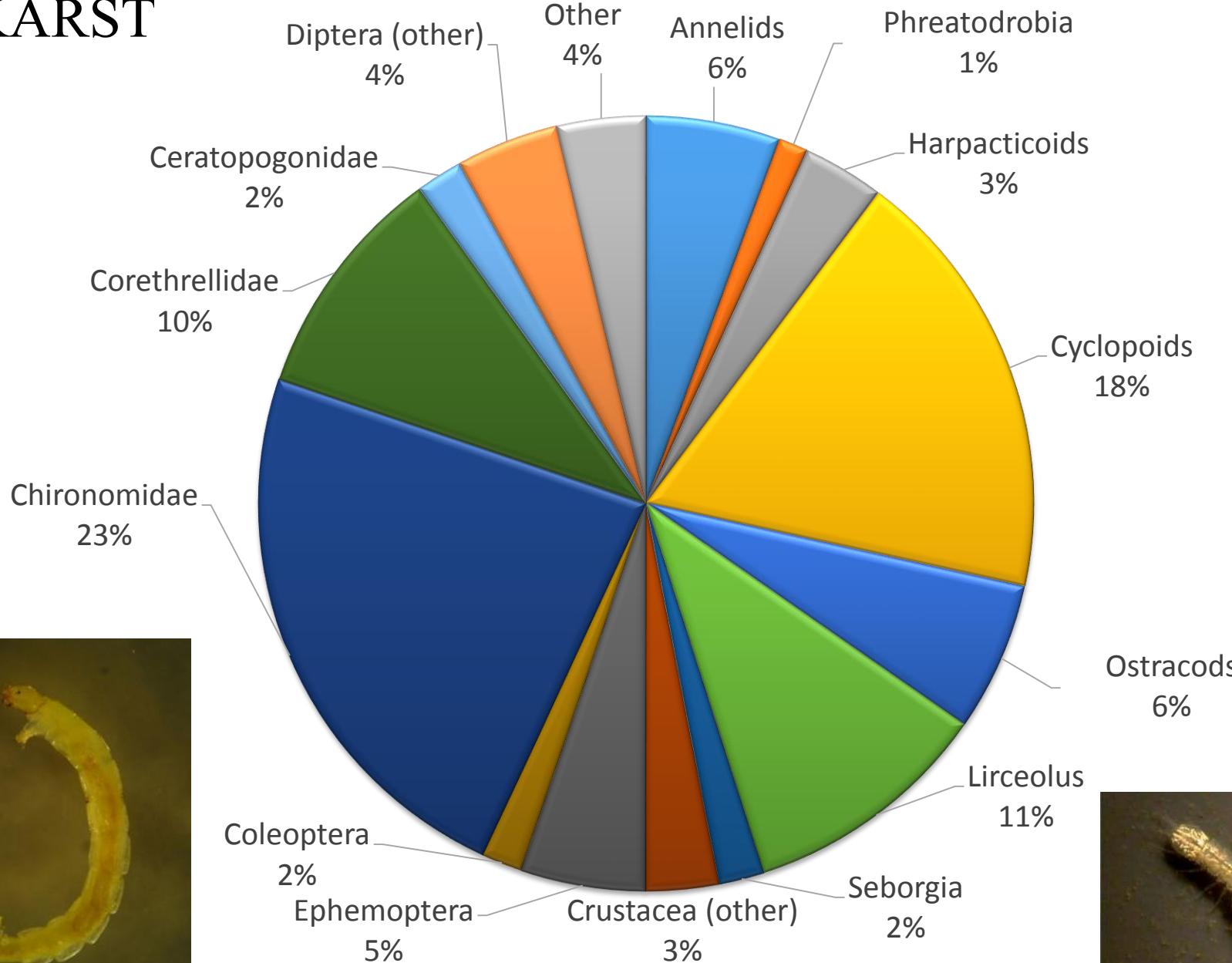
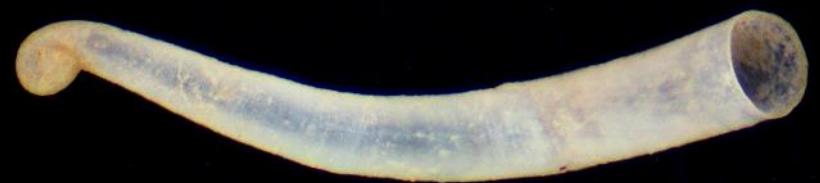


Photo: J. Krejca

# New Habitat

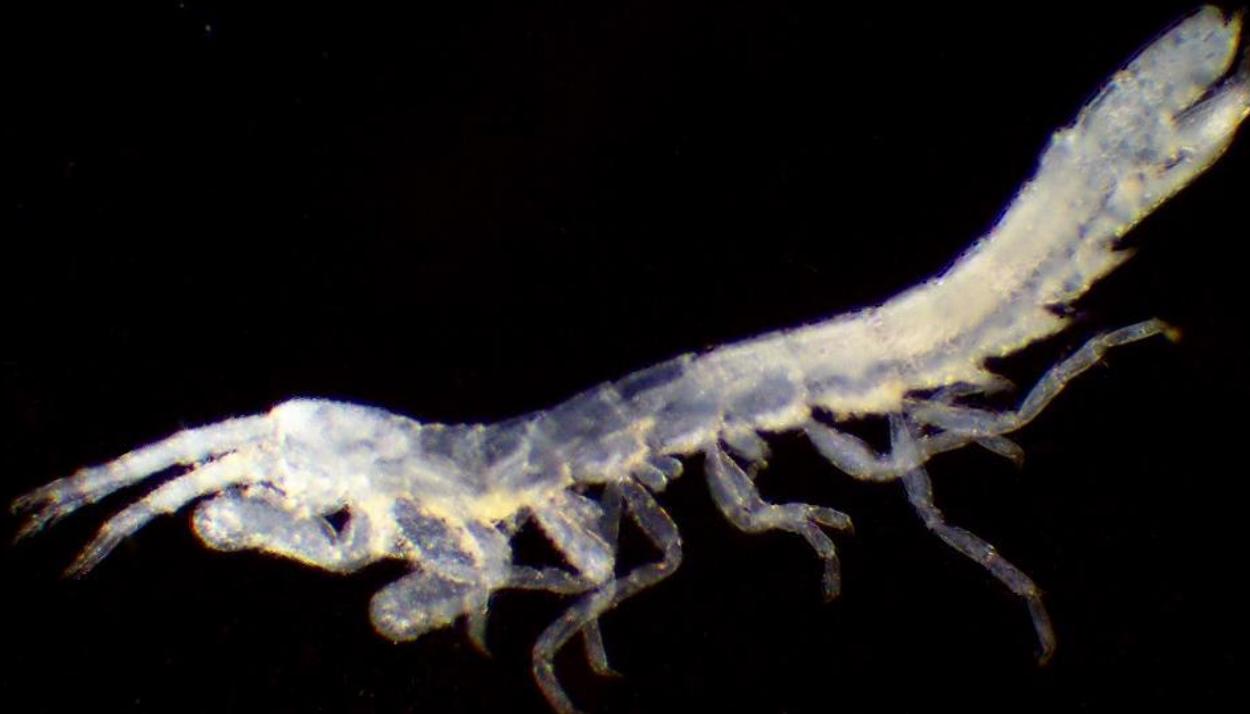
- *Phreatodrobia* sp.
- *Phreatoceras taylori*
- *Texanobathynella* sp.\*
- *Lirceolus cocytus*
- *Lirceolus hardeni*
- *Parabogidiella americana*\*
- *Artesia subterranea*
- *Seborgia hershleri*\*
- *Haideoporoides* sp.\*
- *Microcerberidae* n. sp.
- *Hadziidae* n. sp.
- *Stygobromus* n. sp.
- *Ingolfiellidae* n. sp.



# Taxonomy problem



# Rio Grande oddities



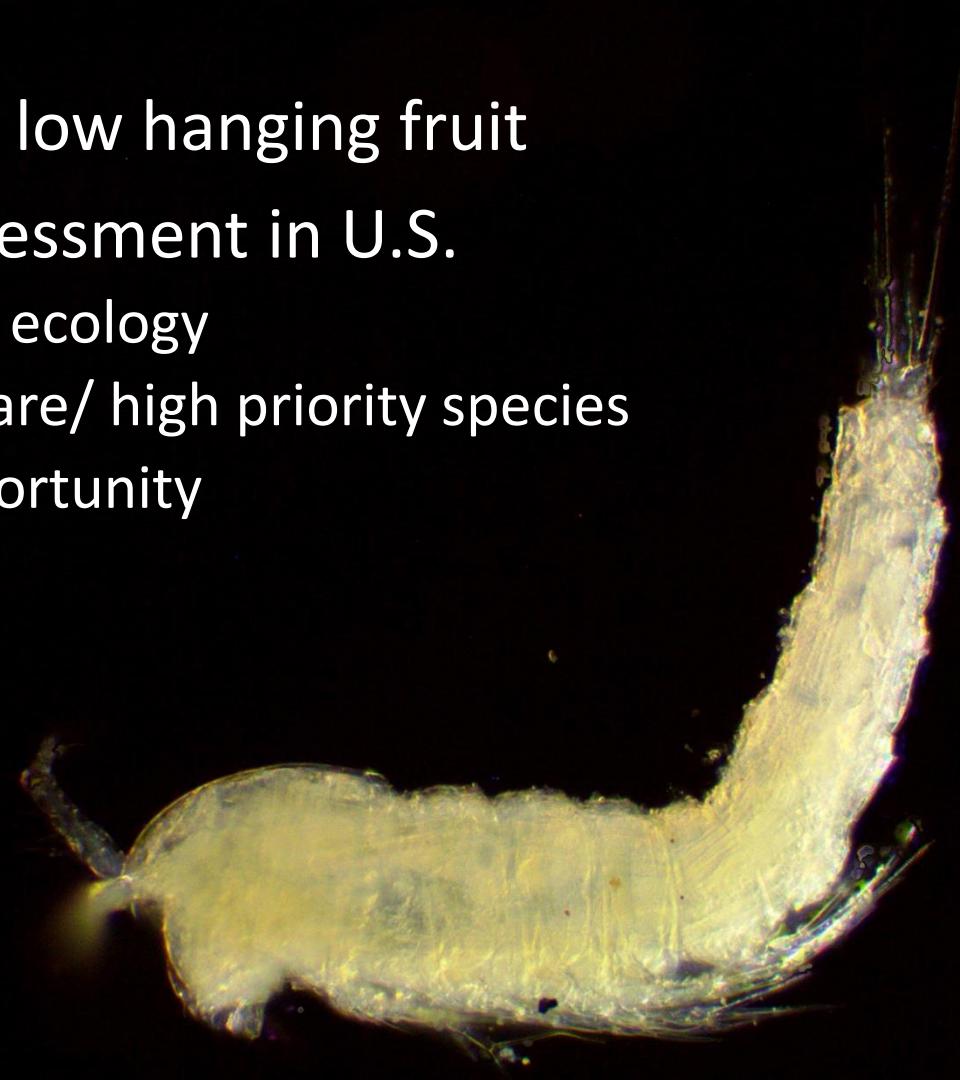
# Summary of fauna composition

- 18 stygobiont taxa
- 13 species first occurrence in hyporheic
- 4 range extensions
- 40 new stygobiont occurrence records

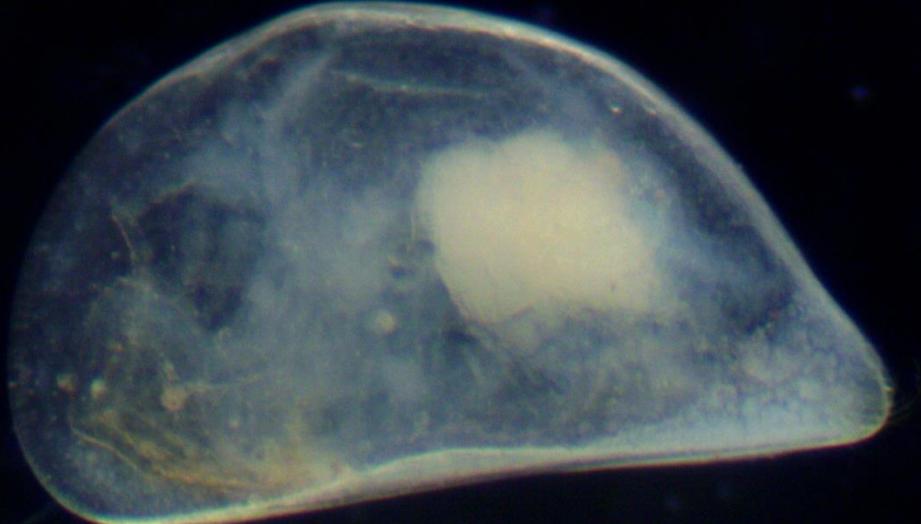


# Discussion

- Hyporheic sampling is low hanging fruit
- Lack of systematic assessment in U.S.
  - Importance to stream ecology
  - Presence of globally rare/ high priority species
  - Greater sampling opportunity



# Thank You



# Water chemistry signal unclear

- Heterogeneity
  - Physical
  - Chemical
  - Temporal



# Thank You

